EFFECT OF STORAGE CONDITIONS ON THE VIABILITY OF TOBACCO SEED[1]

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INTRODUCTION AND REVIEW OF LITERATURE

Seed of cigar-wrapper tobacco stored in ordinary rooms in Florida for more than 2 or 3 years seldom remains sufficiently viable to plant. Farmers who sow seed older than this without testing the germination are often disappointed in the resulting stand and vigor of the seedlings. Likewise, in Puerto Rico, "the Tobacco Institute does not recommend the use of tobacco seed after the second year."[2]

On the other hand, tobacco seed has been reported to retain its viability for much longer periods in colder climates. Johnson, Murwin, and Ogden (*4*)[3] reported that in Wisconsin, "seed that was originally of good germinating capacity may be quite satisfactory for commercial purposes when 10 years old." It is reported (*2*) that in Connecticut, "high testing seed in general shows very little diminution in germinative capacity up to 5 years; after that the percentage usually falls gradually, although occasionally there is excellent germination at 10 years."

Shamel and Cobey (*7*) stated that "thoroughly dry seed may be shelled and stored in glass vials or bottles with perfect safety, and can be kept almost indefinitely in this way; the fully matured and dry tobacco seed will retain its viability when kept dry for 10 years, or, as has been observed in several cases, a much longer time."

Chirkovskiĭ (*1*) reported that optimum storage conditions for tobacco seed are low temperature, but above freezing, and low relative humidity.

Poptzoff (*6*) found that the higher the storage temperature used for tobacco seed, the lower must be the relative humidity. He further claims that there is no such thing as a lower limit of relative humidity, for the lower it is, the greater the certainty of conserving the quality of the seed.

EXPERIMENTAL WORK

An experiment to determine some of the factors affecting the longevity of tobacco seed in storage was started at Quincy, Fla. in August 1931 with freshly harvested seed of a cigar-wrapper variety, No. 301. The original moisture content of the seed was estimated by drying to constant weight at 102° C.

Three series of tests were conducted, as follows:

1. Seed was stored in small vials enclosed in 4-ounce screw-cap glass jars over various chemicals, which kept the relative humidity of the air fairly constant at values determined from chemical reference works. The chemicals used were anhydrous calcium chloride ($CaCl_2$), Rochelle salt ($KNaC_4H_4O_6 \cdot 4H_2O$), ferrous sulfate ($FeSO_4 \cdot 7H_2O$), a

[1] Received for publication February 2, 1943.
[2] Letter from Dr. H. H. Foster, dated June 1, 1942.
[3] Italic numbers in parentheses refer to Literature Cited, p. 410.

saturated solution of ammonium nitrate (NH_4NO_3) with an excess of the salt, and water.

2. Seed was stored in rubber-stoppered vials after the moisture content, originally about 9 percent, had been adjusted to various percentages by placing samples in a moist chamber or a desiccator for various lengths of time. No attempt was made to restore the moisture content to its original value each year when the vials were opened for sampling.

3. Seed with the original moisture content was stored in rubber-stoppered vials, paper envelopes, and cloth bags, and kept in various locations, as follows: Refrigerator, electric, fairly constant at 5° C.; basement room, unheated; laboratory, intermittently heated in winter; and an attic, cold in winter and extremely hot in summer.

No attempt was made to control the amount of light received by the seed during storage. All containers were exposed to diffused daylight at least part of the time.

In October 1932 and at intervals of about a year thereafter, each lot of seed in storage was poured out, mixed, and sampled for the germination test. Any desiccants which appeared to have deteriorated were renewed, and the seeds were returned to storage.

Tests were made on triplicate samples of 100 seeds each, in Petri dishes on two sheets of wet filter paper. The light requirement for the germination of these seeds at constant temperature (*5*) was satisfied by opening the incubator nearly every day. The testing procedure provided favorable conditions for germination, as shown by the fact that every year some tests averaged 80 percent or more. At convenient intervals of a few days, seedlings were counted and removed from the dishes, until further incubation of a few days gave little or no further germination. The averages of triplicate germination tests for each of the 11 years of the experiment to date are given in table 1.

Seeds stored in the refrigerator over the three salts, calcium chloride, Rochelle salt, and ferrous sulfate, retained their viability for 11 years. Those stored over a saturated solution of ammonium nitrate deteriorated considerably, and those stored over water were all dead at the end of 1 year.

Seeds stored in either the basement, laboratory, or attic over calcium chloride retained their viability for 11 years. Those stored over the other salts or the salt solution were all dead after from 2 to 5 years, and those stored over water were all dead at the end of 1 year.

Seeds stored in stoppered vials with an original moisture content of 5.3 percent or less showed a small percentage of germination after 8 years; they would probably have remained viable much longer if the original moisture content had been restored at suitable intervals. With each increment in original moisture content the survival period decreased, until at 10.7 percent moisture, nearly all the seeds were dead after 1 year.

Seeds stored in stoppered vials, paper envelopes, or cloth bags kept well in the refrigerator, but in the other three locations all or nearly all were dead after 3 years.

Samples from each of the nine lots of seed which germinated 79 percent or more after 10 years in storage were sowed in an ordinary outdoor plant bed in 1942. The stand and growth appeared just as good as were obtained with fresh seed of the same variety.

TABLE 1.—*Germination of tobacco seed after storage under various conditions and for various periods*

How stored	Where stored	Approximate relative humidity inside container	Original moisture content of seed	Germination after number of years indicated										
				1	2	3	4	5	6	7	8	9	10	11
Over chemicals:		*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
$CaCl_2$	Refrigerator	1	9	85	50	23	58	76	73	48	78	84	82	88
$KNa(C_4H_4O_6).4H_2O$	do	30	9	86	45	19	60	87	74	67	85	80	85	89
$FeSO_4.7H_2O$	do	[1] 50	9	79	34	23	58	80	70	55	86	86	88	82
NH_4NO_3 [2]	do	70	9	80	70	63	70	73	67	51	58	49	51	42
H_2O	do	100	9	0										
$CaCl_2$	Basement	1	9	65	54	53	69	86	84	81	87	87	91	86
$KNa(C_4H_4O_6).4H_2O$	do	40	9	51	0	0	0							
$FeSO_4.7H_2O$	do	60	9	65	6	0	0							
NH_4NO_3 [2]	do	60	9	81	60	47								
H_2O	do	100	9	0										
$CaCl_2$	Laboratory	1	9	78	52	46	76	57	83	72	75	87	83	79
$KNa(C_4H_4O_6).4H_2O$	do	40	9	77	45	30	1	0						
$FeSO_4.7H_2O$	do	60	9	82	49	40	11	0						
NH_4NO_3 [2]	do	60	9	83	55	60	3	0						
H_2O	do	100	9	0										
$CaCl_2$	Attic	1	9	81	56	60	80	82	79	77	81	74	79	83
$KNa(C_4H_4O_6).4H_2O$	do	40	9	76	54	43	0	0						
$FeSO_4.7H_2O$	do	60	9	67	16	2	0							
NH_4NO_3 [2]	do	60	9	81	31	0	0							
H_2O	do	100	9	0										
In stoppered vials	Laboratory	2.8	9	89	63	84	77	62	27	14	2	0		
	do	4.3	9	80	71	79	68	66	36	7	3	0		
	do	5.3	9	92	78	80	77	69	46	12	11	0	0	
	do	6.8	9	87	80	68	41	18	3	0				
	do	8.0	9	79	64	57	16	0						
	do	9.0	9	70	25	0	0							
	do	10.7	9	2	0	0	0							
In various containers:														
Stoppered vial	Refrigerator		9	76	49	24	60	89	75	65	81	83	86	83
Paper envelop	do		9	77		14	35	85	68	69	81	82	85	84
Cloth bag	do		9	61		20	70	78	77	70	77	83	81	73
Stoppered vial	Basement		9	63	8	0	0							
Stoppered vial	Laboratory		9	60	16	0	0							
Paper envelop	do		9	63	28	1	0							
Cloth bag	do		9	72	29	2	0							
Stoppered vial	Attic		9	49	1	0	0							

[1] Estimated from values found for $CoSO_4.7H_2O$.
[2] Saturated solution.

It is planned to continue the experiment at least as long as any of the samples keep satisfactory viability.

DISCUSSION

Practical methods for storing tobacco seed for 11 years, perhaps much longer, are suggested by the results of this experiment.

Ordinary desiccators containing calcium chloride, or probably any other good desiccant, may be used. A desiccator can be improvised from any tight container of glass or metal, using anhydrous calcium chloride and a false bottom to support the seed. Drying the seed in a desiccator and then storing it in a tight container would probably be satisfactory.

Storage in an electric refrigerator at a temperature a few degrees above freezing, with the seed enclosed in ordinary containers, gave as good results as dry storage at any temperature tested. Storage in an ice refrigerator would probably not be as satisfactory, because of the higher humidity and usually higher temperature.

Farmers who produce a supply of tobacco seed sufficient for several years may preserve it for many years by suitable storage. Such a

supply of seed may be valued more highly after one or more satisfactory crops have been produced from it. The importance of being able to preserve experimental lots of tobacco seed for long periods need not be discussed here.

Several samples, especially those stored in the refrigerator, showed a decline in germination test during the first 3 years in storage, and afterwards returned to a high test. Similar results have been reported by Goodspeed (*3*) and by Johnson, Murwin, and Ogden (*4*). No explanation can be offered, but it seems improbable that this kind of result was due to the conditions of the germination tests, because every year some of the tests averaged 80 percent or more. Another storage experiment has been started, in which this phenomenon will be given special attention.

SUMMARY

Cigar-wrapper tobacco seed of the 1931 crop was placed in storage at Quincy, Fla., immediately after harvest (1) in closed containers over various chemicals, (2) in rubber-stoppered vials with the moisture content of the seed adjusted and determined, and (3) in various containers. Test lots were kept in different locations, as follows: Refrigerator at about 5° C., basement, laboratory, and attic.

After 11 years, seed stored over calcium chloride in each location, and seed stored in various ways in the refrigerator, germinated well in the laboratory. Samples which tested 79 percent or more after 10 years also germinated well in an ordinary outdoor plant bed.

Seed stored in rubber-stoppered vials with an original moisture content of 5.3 percent or less showed a small percentage of germination after 8 years.

Samples stored in ordinary containers in the laboratory were all or nearly all dead after 3 years.

Practical applications of dry or cold storage to commercial and experimental lots of tobacco seed are suggested.

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